THE CHRYSOGASTER (ORTHONEVRA) BELLULA GROUP IN NORTH AMERICA

(DIPTERA : SYRPHIDAE)

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Confusion has existed for some time concerning the identification of the members of the genus *Chrysogaster* Meigen. This paper is the first of a series to treat the genus.

The North American species of the subgenus *Orthonevra* Macquart can be divided into several groups based on eye maculations. The species to be treated here exhibit several vertical brown stripes in addition to a single transverse stripe. The Central and South American species of this group will be covered in a later paper.

The species of the *bellula* group show close similarity in basic structure. The following description will serve as a general guide to their characteristics.

GENERAL MORPHOLOGY OF THE bellula GROUP

Head. Face black with bluish reflections; purplish reflections predominate in the area adjacent to the lateral silvery gray pollinose side-spots present at the level of the antennae; a triangular azure-blue spot is typical of the upper portion of the supraepistomal concavity; epistoma projects to or slightly beyond the gradual facial bulge below the antennae; the lateral areas of the face roughened into the form of longitudinal wrinkles which continue onto the front; lateral triangular pollinose side-spots small, not extending more than 1/4 the distance across the face; median facial area below antennae devoid of deep wrinkles or pile, with very fine transverse striations; front aeneous medially, excavated with deep, more or less irregular grooves; cheeks polished black; antennae elongate, brownish, usually lighter below, with light pile below and dark pile above on second antennal segment; eyes light brown with dark brown markings in the form of vertical stripes and a single transverse stripe; head clothed with whilte pile or scales, generally rather sparse.

Thorax. Scutum shining light blue, with deep, coarse punctures, and four subopaque broad brown to purple vittae, and usually one pair of linear lateral vittae; mesopleura, pteropleura, and hypopleura, with numberous coarse punctures and sparse white ple, with bluish reflections anteriorly and purplish posteriorly; remainder of pleural area polished black and devoid of pile; wings with apical crossvein at right angles to the third longitudinal vein; wings with brownish clouds along the crossveins and with diffuse brownish spots in the wing cells; squamae white, often brown below; halteres white to yellow, the knob darker; legs shining black, often with purplish reflections, the basal tarsal segments and portions of the tibiae, yellow; scutellum subquadrate, blue along the margin and purple medially, without a ventral fringe; post-scutellum with a shining blue area surrounded by a white pollinose area.

Abdomen. Dorsal opaque surface bluish or green, usually with opaque purple or bronze at apices of second and third, and sometines fourth, segments; lateral shining

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black margin of abdomen with varying amounts of shining purple which is continuous with the purple of the dorsum; ventral surface shining black with appressed white pile; fourth sternite asymmetrical in male, with a weak lobe at right apical extremity; last tergite of female pre-abdomen (segment five) gently concave posteriorly.

Length. Overall length, excluding antennae, of males 4.5–6 mm., females 5–7 mm.

The following key will separate the species of this group known to occur in North America, north of Mexico.

KEY TO THE SPECIES OF THE **bellula** GROUP

1. Face with normal pile, devoid of scales 2
   Face without pile, clothed with scales 4
2. Second antennal segment subequal in length to third ..... **bellula** Williston
   Second antennal segment definitely shorter than third, usually one-half as long as third 3
3. Eyes with three vertical stripes (fig. 7) ..... **nitidula** Curran
   Eyes with two vertical stripes (fig. 6) ..... **sonorensis,** n. sp.
4. Second longitudinal vein terminates at same level as the junctio between the third longitudinal vein and apical crossvein (last section of fourth longitudinal vein); brown wing markings on these veins forming a broad band at right angles to costa (fig. 12) ..... **flukei,** n. sp.
   Second longitudinal vein ends basad of the junction between the third longitudinal vein and apical corssvein; brown markings on these veins disconnected or curve , never forming a straight single broad band (fig. 14) ..... **nitida** Wiedemann

Chrysogaster (Orthonevra) bellula Williston

Chrysogaster bellulus Williston, 1882, Trans. Amer. Phil. Soc. 20: 304.

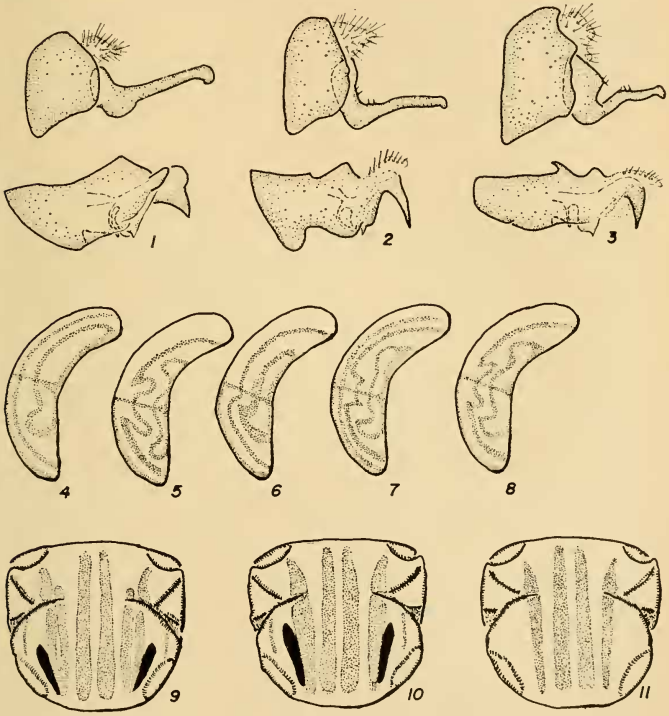
This is a relatively large and distinctive species. The hairy face which is almost shaggy, elongate second antennal segment, simple eye markings (fig. 4), and distinctive male genitalia (Sedman, 1959), will separate this species from all others in the group. The second antennal segment is always shorter than the third, but it is subequal in length to the third. The male genitalia are quite aberrant and their general enlargement results in the hook-like ejaculatory hood being exposed in dried specimens. The purple scutal markings are rather unique. This is the only species of the group which does not possess a linear stripe between the posterior calli and thoracic suture, nor is a shining purple area visible lateral to the outer scutal stripes (fig. 11). The length of the males is 5-6 mm., the females 6-7 mm.

The geographic distribution is also distinctive. The species is common at high elevations in Washington, Oregon, and Idaho, and is also common throughout Utah, California, Arizona, Nevada, and New Mexico. I have not seen any specimens from Mexico.

C. (O.) nitidula Curran

Chrysogaster nitidula Curran, 1924, Kans. Univ. Sci. Bull. 15: 116.

Although this species had not been recognized since its description, it is an easily distinguished species. The following combination of characteristics will separate it from the other members of this group: three



Figs. 1–3, Male genitalia. Fig. 1, *Chrysogaster* (*Orthonevra*) *sonorensis*, n. sp.; fig. 2, *C.* (*O.*) *nitidula* Curran; fig. 3, *C.* (*O.*) *flukei*, n. sp. Figs. 4–8, Eye markings. Fig. 4, *C.* (*O.*) *bellula* Will; fig. 5, *C.* (*O.*) *nitida* Wied; fig. 6, *C.* (*O.*) *sonorensis*, n. sp.; fig. 7, *C.* (*O.*) *nitidula* Curran; fig. 8, *C.* (*O.*) *flukei*, n. sp. Figs. 9–11, Scutal pattern, stippled areas represent opaque purple, black areas represent shining purple. Fig. 9, *C.* (*O.*) *nitida* Wied.; fig. 10, *C.* (*O.*) *flukei*, n. sp. (identical with *sonorensis*, n. sp. and *nitidula* Curran); fig. 11, *C.* (*O.*) *bellula* Will.

vertical stripes separated from the eye margins, anterior two sinuous, posterior one gently curved (fig. 7); second antennal segment almost one-half of the length of the third; wing with apex of second vein and junction between apical crossvein and third longitudinal vein approximately the same distance from wing base, and with a broad brown cloud over and connecting them (fig. 15); face with sparse, normal white hair.

I have not examined the type of this species, but a number of topotypes were available and there can be no mistake about the identity of the species. The male genitalia are symmetrical and distinctive, and are illustrated for the first time (fig. 2).

The geographic distribution of this species is limited to southern Arizona, Texas, and New Mexico. It would appear that further collecting will result in records from the states of Northern Mexico.

C. (O.) sonorensis, n. sp.

Male. Eyes with two median brownish stripes which are moderately sinuous below the transverse stripe, otherwise gently following the contour of the eye; the anterior and posterior margins of the eyes with normal brown markings (fig. 6). Facial color black with bluish reflection; pile normal, white. Antennae with third segment approximately twice as long as the second; color reddish, brownish above on third segment. Pile sparse.

Scutum bluish with four opaque longitudinal purple stripes which are broadened posteriorly; a linear stripe between the posterior calli and the scutal suture. Scutellum bluish on margin and shining purple elsewhere. Legs shining black, yellow on basal two segments of the tarsi. Wings with broad brown cloud on apical crossvein and over marginal cell; 2nd longitudinal vein proximal to apical crossvein, the latter slightly recurrent, and the cloud slightly diagonal in position (fig. 13).

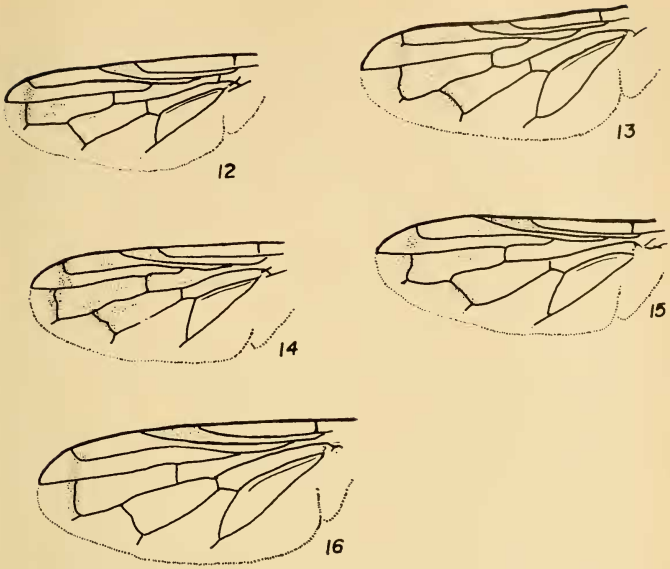
Abdomen washed-out opaque blue, with opaque purplish markings at base of segments two and three, and sometimes four; this purple broadened laterally, and shining on the polished black margins. Genitalia of the male symmetrical; the ejaculatory hood shows some variation from that illustrated (fig. 1), and in some individuals is closer to the shape illustrated for *flukei*, n. sp. (fig. 2).

Female. Front with definite longitudinal groove, apical crossvein not quite so recurrent, otherwise like male.

Length. Male 4.5 mm., Female 5.5.

Holotype, male, from Catalina Mts., Ariz., Htchk. Hwy. Mi. 19, 18 July 1955, F. G. Werner and G. D. Butler, in the collection of the University of Arizona. Allotype, female, same data.

Paratypes. ARIZONA: Catalina Mts., Htchk. Hwy. Mo. 19, 18 July 1955, F. G. Werner and G. D. Butler, *Ceanothus*, 2 males; 22 Aug. 1955, *Ceanothus Greggi*, 1 male. Chiracahua Mts., 5 July 1950, D. E, Hardy, 2 males; 3 July 1947, L. D. Beamer, 1 male. Rustler's Park. Chiracahua Mts., 5 July 1940, D. E. Hardy, 1 female. Santa Catalina Mts., 14 July 1950, L. D. Beamer, 1 male, 1 female. NEW MEXICO: Jemez Springs, 1 July 1941, B. Hodgen 2 males.



Figs. 12–16. Wings. Fig. 12, *C.* (*O.*) *flukei*, n. sp.; fig. 13, *C.* (*O.*) *sonorensis*, n. sp.; fig. 14, *C.* (*O.*) *nitida* Wied.; fig. 15, *C.* (*O.*) *nitidula* Curran; fig. 16, *C.* (*O.*) *bellula* Will.

The geographic distribution is limited to southwestern United States. Like *nitidula* Curran, it seems reasonable that it also occurs in the northern states of Mexico.

This species may be confused with *nitidula*, since it has a similar distribution, short second antennal segment, and lacks facial scales. It is easily separated from *nitidula* by the distinctive genitalia and by the eye markings. In *sonorensis*, the superior lobes of the male genitalia are well developed and spinose, while in *nitidula* the lobes are degenerate and merely appear as weak ridges along the anterior margin of the penis sheath. The eye maculations are similar to those of *bellula* Will., but the short second antennal segment and sparse facial pile of *sonorensis* separate these species.

C. (O.) flukei, n. sp.

Male. Eye markings sinuous, varying from two parallel brown bands to coalescing bands which result in one or more sets of circular markings (fig. 8). Face aeneous black with some purple and bluish reflection; devoid of normal pile; scales of face

evenly distributed laterally, except for a line along the eye margin where they are more concentrated, and absent along a broad median line from the antennae to the epistoma; epistoma projecting almost as far as facial bulge. Antennae brownish, 1st segment often yellowish; segment three longer than two but subequal in length. Cheeks shining black with white scales anteriorly, and white pile posteriorly. Front aeneous, often purplish centrally; scales present. Vertex aeneous, pile blackish; ocellar triangle raised.

Thorax greenish or weakly bluish, with four broad longitudinal purplish stripes and two narrow purplish streaks between posterior calli and thoracic suture; pile short and white on scutum. Scutellum bluish on margin and shining purple elsewhere. Legs shining black, yellow on basal two tarsal segments and basal 1/4 of hind tibiae. Wings with apical crossvein clouded, connected to cloud on 2nd longitudinal vein; brown spots of variable intensity in wing cells; stigma dilute yellow. Halteres pale yellow. Squamae white with darkened margin.

Lateral margins of abdomen shining blue on first abdominal segment, purplish on remaining segments, or remaining segments more or less blue basally, with purple restricted to some portion of the apical margins. Dorsum of abdomen subopaque blue, more or less subopaque purple or bronze on apical portions of segments two, three, and four. Genitalia symmetrical; cerci longer than broad.

Female. Front narrowed above with a longitudinal depression and more or less distinctive grooves laterally; white pile present on upper angles of front in addition to the abundant white scales; vertex with white pile; stigmal cell of wing darker; lateral margins of first segment of abdomen shining black, remainder usually purple.

Lenth. Male, 4.5 mm., female 5.5.

Holotype— male from 17 mi. E. Douglas, Ariz., Cochise Co, 8August 1958, C. G. Moore, in the collection of the University of California at Davis. Allotype, female, same data.

Paratypes. ARIZONA: Bill Wms. Fork, Aug., F. H. Snow, 1 male. Canelo, 3 Aug. 1956, G. D. Butler, 1 male. Catalina Mts., Htchk. Hwy. Mil. 19, 9 July 1957, F. G. Werner, *Ceanothus*, 1 female; 18 July 1955, F. G. Werner and G. D. Butler, *Ceanothus Greggi*, 1 male. Chino Valley, 27 July 1956, Gebhardt & Butler, swept/alfalfa, 1 female. 8 mi. E. Douglas, Cochise Co., 8 August 1958, C. G. Moore, 1 male. 17 mi. E. Douglas, Cochise Co., 4 August 1958, C. G. Moore, P. Opler, D. D. Linsdale, 7 males; 8 August 1958, G. B. Pitman, R. H. James, C. G. Moore, P. D. Hurd, 1 female, 15 males. 18 mi. N. Douglas, 4500', 30 July 1946, H. A. Scullen, 1 male. Elfrida, 11 July 1955, G. D. Butler, swept/alfalfa, 1 female. Florida Canyon, Santa Rita Mts., Pima Co., 20 July 1959, G. A. Samuelson, 1 male. Granite Dell, 11 July 1941, L. H. Banker, 1 female. Herb Martyr Dam, Cochise Co., 12 September 1958, H. V. Weems, Jr., 1 female. John Hand Park, Cochise Co., 12 September 1958, H. V. Weems, Jr., 2 males. 9 mi. E. Lochiel, 7 Sept. 1955, G. Butler-F. Werner, *Petalostemum candidum*, 1 female. Madera Canyon, Santa Rita Mts., 1 June 1961. R. H. and E. M. Painter, 1 male. Nogales, 7 June 1957, G. D. Butler, *Conium*, 1 female. Oak Creek Canon, July, 6000', F. H. Snow, 2 females, 4 males; Aug., F. H. Snow, 1 male. w. sl. Patagonia Mts., Santa Cruz Co., 7 Sept. 1955, F. G. Werner and G. D. Butler, 3 females, 4 males. Pinery Canyon, Chiricahua Mts., 6000',

9 July 1955, G. D. Butler and F. G. Werner, 1 female. 8 mi. W. Portal, cochise Co., 5400', 12 July 1956, E. Ordway, 1 male. Prescott, 27 June 1932, Timberlake, 1 female. Ramsey Canyon, Huachuca Mts., 18 July 1942, vzn Dyke, 1 male. Ruby, 16 Aug. 1961, F. Werner, 1 female. San Bernardino Ranch, Cochise Co., 3750 ft., August, F. H. Snow, 1 female. Santa Rita Mts., 17 July 1932. R. H. Beamer, 1 female, 3 males. S. Arizona, Aug. 1902, F. H. Snow, 1 male. Sunnyside Canyon, Huachuca Mts., 9 July 1940, R. H. Beamer, D. E. Hardy, L. J. Lipovsky, E. E. Kenaga, 2 females, 38 males. Tanque Verde, 19 September 1954, F. Werner, *Baccharis*, 1 female. Tucson, 10 Nov. 1955, G. D. Butler, swept/alfalfa, 1 male. CALIFORNIA: Alpine, San Diego Co., 13 Sept. 1923, E. P. Van Duzee, 1 female. Campo, 18 July 1940, R. H. Beamer and D. E. Hardy, 3 males. Coachella, 14 May 1917, E. P. Van Duzee, 1 male. Laguna Mts., 6 July 1929, R. H. Beamer, 1 male. 2 mi. N. E. Lakeside, San Diego Co., 29 March 1961, P. D. Hurd, *Salix laevigata*, 1 female. Milton, 21 Oct. 1917, J. C. Bradley, 1 male. Mission Canyon, 1 Oct. 1932. Timberlake, 1 male. Oro Grande, 26 Oct. 1951, Timberlake, 1 female, 2 males. Redlands, 1912, F. R. Cole, 1 male. Resting Springs, Inyo Co., 29-30 May 1955, Belkin et al, 1 female. Riverside, 11 March 1925, 1 female, 1 male; 13 March 1925, 1 female; 5 May 1940, 1 female; 24 May 1925, 2 males; 30 May 1925, 2 females; 29 Aug. 1926, 1 male; 22 Sept. 1929, 1 male; 29 Sept. 1928, 2 males; 8 Oct. 1939, 1 male; 24 Dec. 1934, 1 female; P. H. Timberlake. San Antonio R. S., Santa Clara Co., 27 June 1953, R. O. Schuster, 1 male. San Diego, 7 May 1913, E. P. VanDuzee, 1 male. Temecula, Riverside Co., 4 July 1950, E. G. Linsley, 2 males. Watts Valley, Fresno Co., 23 June 1956, R. O. Schuster, 2 males. NEVADA: Las Vegas, 17 Sept. 1908, J. C. Bradley, 1 female. TEXAS: Juno, Devils River, 13 June 1953, W. W. Wirth, 1 female, 1 male. Kendall Co., 22 July 1938, R. H. Beamer, 1 male. Marathon, 9 July 1938, R. H. Beamer, 1 female, 1 male. Kerrville, 22 April 1908, F. C. Pratt, 1 male. BAJA CALIFORNIA (MEXICO): Mulege, 14 May 1921, E. P. Van Duzee, 1 male. CHIAPAS (MEXICO): Ocosingo, 9 March 1953, Bechtel and Schlinger, 1 male. JALISCO (MEXICO): Chapala, 11 Sept. 1938, L. J. Lipowsky, 1 male. MORALES (MEXICO): Cuernavaca, April 1945, N. L. Krauss, 1 male. NUEVO LEON (MEXICO): 4 mi. W. El Cercado. 6 June 1951, P. D. Hurd, 1 male. OCCIDENTAL (MEXICO): Guadalajara, 1909, McConnell, 1 female, 2 males. SONORA (MEXICO): 10 mi. E. Cananea, 16 August 1959, W. L. Nutting and F. G. Werner, 1 female.

This species has a rather unique distribution amongst Syrphidae. It ranges from California and Nevada into Neotropical Mexico without any specimens yet taken in South America.

I am pleased to name this species after the late Charles Lewis Fluke.

C. (O.) nitida Wiedeman

Chrysogaster nitidus Wiedemann, 1830, Aussereurop. Zweifl. Ins. 2: 116.
Paragus aeneus Walker, 1849, List spec. dipt. ins., Brit. Mus 3: 545.
Cryptineura hieroglyphica Bigot, 1859, Rev. et Mag. de Zool., p 308.

This is only species of this group occuring in eastern North America. It has been recorded from South and Central America (Williston, 1892; Schiner, 1868) but on examination of the specimens in question, the identifications have been found to be incorrect. This species bears a close relationship with one species in western United States, *flukei*, and with a number of Central and South American species. *C.* (*O.*) *nitida*, *flukei*, and the Neotropical associates, exhibit eye markings of a more and more involved nature as well as white scales on the face and front.

It is likely that there may be some confusion about the separation of North American specimens of *flukei* and *nitida*. The wing characteristic used in the key (fig. 14), the purple scutal markings, and the male genitalia, will make clear the distinction between them.

The male genitalia in *nitida* are asymmetrical and this is the only species in the group with this characteristic (Sedman, 1959). The ejaculatory hood is twisted to the right, and the general asymmetry extends to the epandrial styli. The left style is armed with a distinct upper lope, while the right style is simple. Males of *nitida* will be easily identified without dissection of the genitalia by the projecting left style usually exposed lateral to the cerci. No such lobe exists in *flukei*, and the undersurface of the post-abdomen of the male displays only the partially concealed velvety brown cerci.

The eye markings in *nitida* (fig. 5) are quite distinctive, but this is a character with a considerable range of expression. Specimens in the same series will exhibit great variation in sinuosity of the vertical stripes, and some individuals will show differences between right and left eyes.

The median scutal stripes are simple, but the lateral pair are divided along their length (fig. 9). In *flukei*, the stripes are simple.

The males of *nitida* are often quite small and range from 4.5 to 5.5 mm., the females 5-6 mm.

The geographical distribution of this species is limited to North America. On the basis of the specimens before me, its northernmost records are in Ontario, Quebec, and its southern limits in Florida. I have seen specimens from as far west as Nebraska, Kansas, and Eastern Texas. I have not seen any evidence that this species occurs within the range of the other four Nearctic species of this group.

References

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Sedman, Y. S., 1959. Male Genitalia in the subfamily Cheilosiinae. Genus *Chrysogaster*, *s. l.* Proc. Ent. Soc. Wash. **61**: 49-58.

Williston, S. W., 1892. Order Diptera. pp. 57-88, in Godman, F. D., and O. Salvin, Biologia Centrali-Americana. Insecta. Diptera. **3**: 1-127.

NOTES ON NORTH AMERICAN PIOPHILIDAE II.[1]

(DIPTERA)

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Work on the Piophilidae in the United States National Museum collections, which now include the A. L. Melander collection, has revealed one new species, *Piophila* (*Allopiophila*) *penicillata* (described below) the synonymy of *P.* (*A.*) *oriens* Melander and Spuler 1917 with *P.* (*A.*) *vulgaris* Fallén 1820, and the distinctness of *P.* (*A.*) *atrifrons* Melander and Spuler. Figures are given of the male terminalia of these species, as well as of the sixth sternite of *P.* (*Liopiophila*) *nigrimana* Meigen.

Piophila (Allopiophila) atrifrons Melander and Spuler
(Fig. 1)

1917. Washington Agric. Expt. Sta. Bull. 143: 66.

The types of this species were originally cited as three female specimens. Two from Oroville, Wash., without date, are females; one specimen, from Troy, Idaho, June 14, 1908, is a male and is therefore here selected as lectotype.

This species runs to *P. calceata* Duda in Hennig (1943) and is one of a group including that species, as well as *P. dudai* Frey, *P. pectiniventris* Duda, and the following new species, which are distinguishable with certainty only in the male sex, as Hennig has already remarked with regard to the Duda and Frey species.

Frey (1930; and reproduced in Hennig, 1943) gave an unsatisfactory, distorted figure of the male terminalia of *P. calceata*. *P. atrifrons* is very much like *P. calceata* in the male postabdomen and the possibility that the two forms are synonymous must still be considered; however, the shape of the parts shown by Frey differ from those of figure 1 sufficiently to permit consideration of the two forms as distinct species until such time as a comparison of European material becomes feasible.

The postabdomen of *Piophila* species is very asymmetrical and the andrium is held quite obliquely. In the figures here presented, the andrium has been separated from the protandrium (segments 6, 7, and 8) and shown in full lateral view, but the protandrium and base of the preabdomen are shown from an almost direct (a nearly directly) ventral view.

Examination of the protandrial sternites (6s, 7s) has revealed important differences between species. In *P. atrifrons*, sternite 6 is more or less simple, with a large dextral lobe; sternite 7 is somewhat bifid, with a long, digitiform anterior lobe, posterior to which is a small, blunt process.

[1] For paper I, see these Proceedings, v. 60 : 246 (1958).

The aedeagal apodeme (a_1), or phallodeme, in the three species here discussed is of the shape called *fultella* by Munro (1947) in his study of the African Tephritidae (Trypetidae) and shown by me (Steyskal, 1961) to be characteristic of the Pyrgotidae and Platystomatidae. The base of the aedeagus in *P. atrifrons* bears three short teeth and two forked gonapophyses (g), the anterior branch of the latter blunt and about half as long as other, sharply pointed branch. The hypandrium bears only one pair of processes (p), of characteristic shape.

The long hairs on the inner side of the fore tibia mentioned by Duda (1924, p. 201: "die Vorderschienen sind innen ungewöhnlich lang behaart") in a male specimen from Moscow Mt., Idaho, received from Melander, I do not find in a similar specimen in the U. S. National Museum nor in the type. Nor do I find those hairs any different in a specimen of *P. pectiniventris* Duda (Ilfeld, S.-Harz, leg. et det. Duda) and in the following new species.

Piophila (Allopiophila) penicillata Steyskal, new species
(Fig. 2)

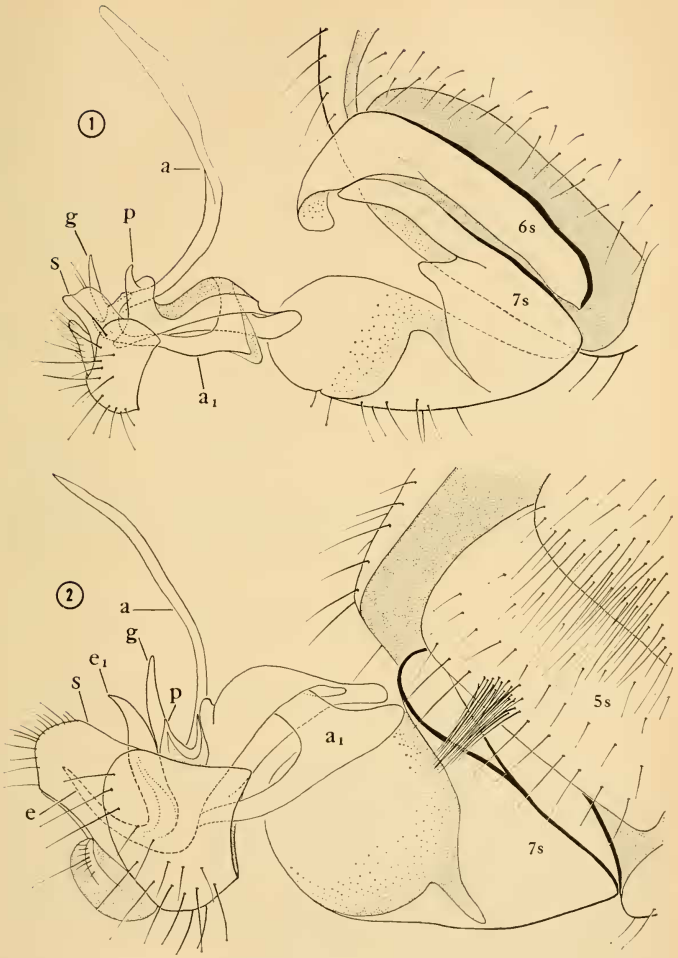
Male. Close to *P. pectiniventris* Duda and so labeled by Malloch some years ago, but differing in bristling of preabdominal sternites and details of postabdomen. Length of body, 2.15–2.86 mm.; of wing, 2.7–3.3 mm. (wings of above-mentioned specimen of *P. pectiniventris* Duda are 2.15 mm. long).

Fifth sternite (5s) mesally near its posterior margin with a tuft of stiff black bristles; those of 4th sternite in the mesal posterior part somewhat longer and more dense but not concentrated into a tuft. Sternites 6 and 7 without special projections.

Andrium differing in a number of details from that figured by Hennig (1943, pl. III, fig. 18) for *P. pectiniventris*, although of very similar structure. Epiphallus (e, e_1) tripartite, with one median posterior spine (e) and a pair of gently backwardly curved lateral spines (e_1); gonapophyses (g) long, ensiform, only gently forwardly curved; posterior process of hypandrium (p) bearing a C-shaped anterior branch lying against the small rounded anterior process; surstyli (S) broad and gently rounded apically, with fringe of hairs of moderate length; proctiger with a pair of sclerotized bands, each of which bears one long bristle and a number of small hairs.

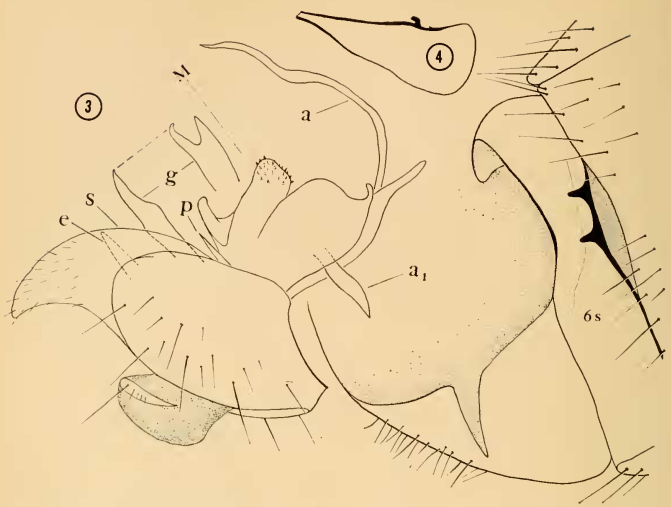
Female. Differs from related species apparently only in the somewhat larger size: Length of body, 2.33–3.22 mm.; of wing, 2.5–3.35 mm.

Holotype, male, and allotype, female, Aklavik, N. W. T., Canada, July 8, 1931; paratypes: Same locality, 9 males and 16 females, June 24 to July 18, 1931, July 18, 1932; Calgary, Alta., one male, May 31, 1924; Edmonton, Alta., one male and two females, May 20, 1924 (all Owen Bryant), Type No. 66858 in the U. S. National Museum. Two females not designated paratypes are also in the collection, one from Banff, Alta., June 13, 1928; the other from Churchill, Man., June 20, 1930 (both Owen Bryant).



Male Terminalia. Fig. 1, *Piophila* (*Allopiophila*) *atrifroms* Mel. and Spuler, holotype. Fig. 2, *P.* (*A.*) *penicillata* Steyskal, n. sp. holotype.

LEGEND: a—aedeagus; a_1—aedeagal apodeme; e, e_1—epiphallus; g—gonapophysis; M—meson; p—process of hypandrium; S—surstylus; 5s, 6s, 7s—5th, 6th.



Male Terminalia. Fig. 3. *P.* (*A.*) *vulgaris* Fallén, holotype of *P. oriens* Mel. and Spuler (syn.). Fig. 4. *P.* (*Liopiophila*) *nigrimana* Meigen, 6th sternite of specimen from Detroit, Mich.

Piophila (Allopiophila) vulgaris Fallén
(Fig. 3)

1820. Heteromyzides Sueciae: 9: (see Hennig, 1943, p. 42 for further synonymy).
1917. *Piophila oriens* Melander and Spuler, 1917. Washington Agric. Expt. Sta. Bull. 143: 63. *New synonym.*

The types of *P. oriens*, cited by Melander and Spuler as "Two males and two females. Ithaca and Geneva, New York, May; Greenfield, Massachusetts, June (Melander)", are now in the U. S. National Museum collections. The specimen labeled "type" is a male from Ithaca, N. Y., May 31, 1914 and is hereby selected as lectotype; the other Ithaca specimen, with the same date, is a female; the Geneva specimen, May 28, 1914, is a male; the Greenfield specimen, June 1, 1914, is a female. The postabdomen of the holotype was macerated and drawn as figure 3, revealing sufficient similarity to the figure given by Hennig (1943, pl. III, fig. 19) to adduce the synonymy.

Gonapophyses in anterior view (g) apically bifid, lateral branch with incurved tip, mesal branch straight. Largest, most anterad of the three processes (p) of hypandrium furnished with a number of stout denticles on mesal face.

Sternite 6 (6s) with a characteristic pair of posteriorly directed teeth midway of posterior margin.

Piophila (Liopiophila) nigrimana Meigen
(Fig. 4)

1826. Syst. Beschr. 5: 396; (see Hennig, 1943, p. 31, for further synonymy).

The sixth sternite of the male of this species, common in North America as well as in the Palaearctic region, bears a characteristic bent prong and a small tooth on its posterior margin, as shown in figure 4. A specimen from Scotland is similar.

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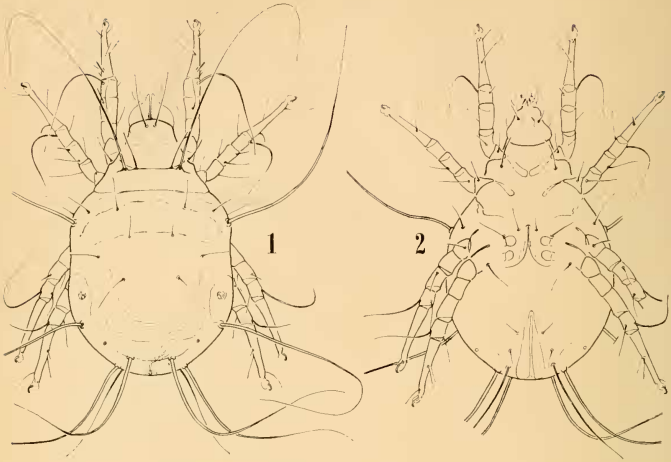
TROPACARUS, A NEW GENUS OF ACARIDAE
(Acarina)

Frederick Cunliffe, *State College Keene, N. H.*

In 1955 E. W. Baker collected an undescribed acarid mite from various leaves in the Congo. These mites lived in small colonies, usually forming a circle, with their bodies oriented inward. Baker again collected this mite in Costa Rica and Nicaragua in 1959, and Fleschner found it on citrus leaves in Assam, India the same year. Muma (1961) records it as feeding on fungus on citrus leaves in Florida. He states: "This mite is usually found in clusters, including eggs, young and adults, along the midrib of the leaf or besides clumps of trash. When disturbed the mites move clumsily about until a hiding place is found or the cluster is relocated." U. S. National Museum records show that this species has also been intercepted from Brazil at U. S. Quarantine.



1. Female, dorsal view; 2. Female, ventral view.

Tropacarus, new genus

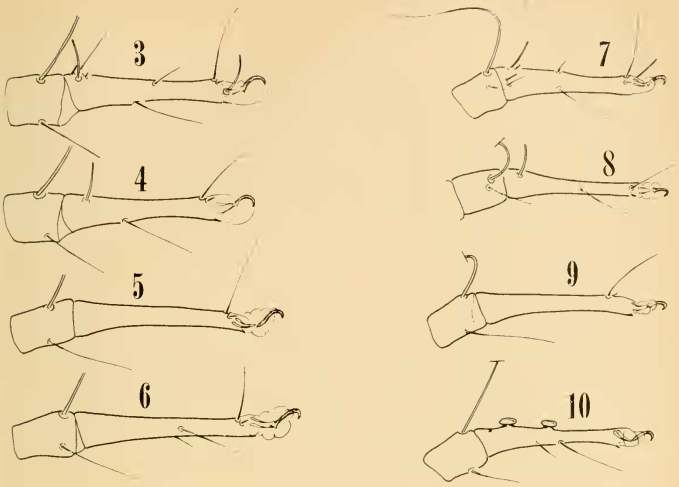
This genus is distinctive in having large genital discs, in having certain of the body setae long and whiplike, in that certain body setae are missing, in lacking most tarsal setae, and in that the male does not have anal discs.

Type. Tropacarus mumai, new species.

Tropacarus mumai, new species
(Figs. 1–10)

Female. Plump, "pale yellow to pale orange with a red-brown to black spot on each side near the back end. Frequently one or two additional dark areas occur in the middle near the back end" (Muma, 1961). Setae sce, he, 1p, d4 and sae are very long and whiplike; pa1 is about half as long as these; the other dorsal body seate are much sorter. Coxae I and III each with a seta; there are three pairs of genital setae, the posterior pair situated almost on coxae IV; there are two pairs of anal setae. The genital discs are large in relation to the body size. Leg setae are fewer in number than in other genera, especially on tarsus I and II. Body length 380 u; width 270 u.

Male. Similar to female. Tarsal IV discs are on the proximal half of the segment. There are no anal discs. Body length 320u; width 210 u.



3, Tarsus and tibia I, female; 4, Tarsus and tibia II, female; 5, Tarsus and tibia III, female; 6, Tarsus and tibia IV, female; 7, Tarsus and tibia I, male; 8, Tarsus and tibia II, male; 9, Tarsus and tibia III, male; 10, Tarsus and tibia IV, male.

The holotype female, U. S. National Museum No. 3039, twelve paratype females, and two paratype males were collected on leaves of "tree", Leopoldville, Congo, April 16, 1955, by E. W. Baker.

Other specimens were collected on *Vitex congolensis*, Stanleyville, April 18, 1955; *Berlinia* sp., same data; frangipani, same data; frangipani, Lwiro, May 17, 1955; peach, Mulunga, May 18, 1955. All were found on the ventral surfaces of the leaves, usually in colonies. The same species has been found in Florida, Costa Rica, Nicaragua, India, and Brazil (U. S. Quarantine).

Reference

Muma, M. H. 1961. Mites associated with citrus in Florida. Univ. Fla. Agr. Expt. Sta. Bull. 640: 1-39.

THREE UNCOMMON GENERA OF THE MITE FAMILY STIGMAEIDAE

(Acarina)

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Some of the species in the mite family Stigmaeidae are rotund, almost globose types which are extensively covered with relatively thick and dimpled or reticulated plates and which have a prominent 3-pronged sensillum on the apex of the palptarsus. The majority of stigmaeids deviate from this form in various ways. Those described here differ radically from the rotund form of anatomical organization; they have slender, fusiform bodies, almost no idiosomal plating, and the palptarsus bears a single lanceolate spine or several discrete, seta-like eupathids on its apex.

The naked, spindle-shaped stigmaeids to be described are rarely found in Berlese funnel concentrates of microarthropods obtained from samples of leaf mold, humus, moss and lichen. Many hundreds of samples from numerous localities have yielded very few specimens. Consequently there are not enough geographical or ecological data to show where significant populations of these mites are likely to occur. The specimens on hand were collected over a period of about 12 years. It is for this reason that they are called rare or uncommon types.

Genus **Apostigmaeus** Grandjean

Apostigmaeus Grandjean, 1944, Arch. des Sci. phys. et nat., 5me Période, 26:105.

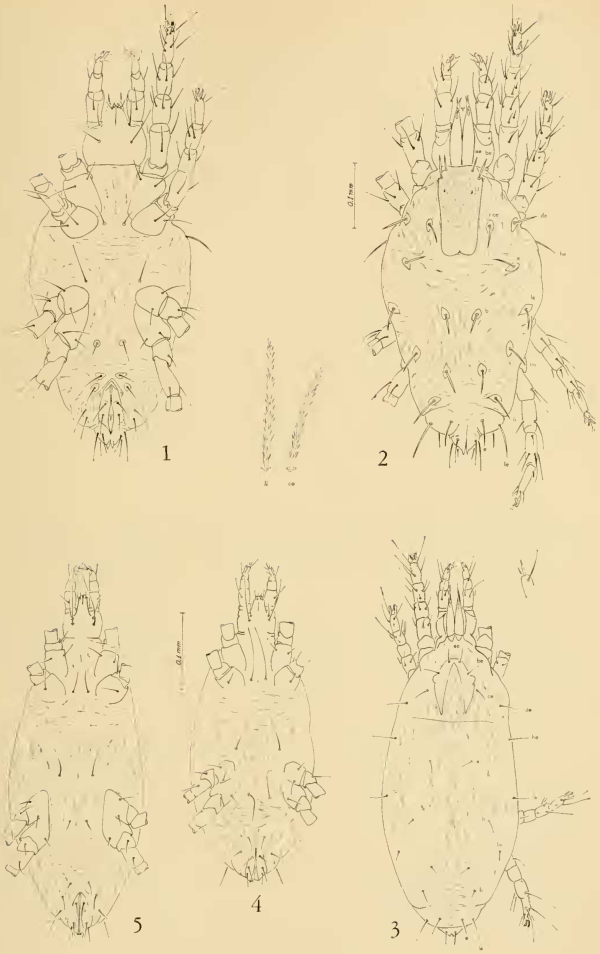
Diagnosis: Stigmaeids having unjoined or separately movable chelicerae and body plating restricted essentially to mid-dorsal section of propodosoma. Propodosomal plate narrow, elongate, bears only setae *ae* and *be*; setae *ce* and *de* not incorporated on this plate. Dorsum of metapodosoma and opisthosoma with sclerotization restricted to very small platelets, one platelet for each seta—except suranals. Dorsal setae: 13–14 pairs. No obvious eyes. Palptarsus slightly longer than tibial claw; it bears a group of minute, simple sensilla instead of an apical trident (multiple eupathid). Tarsus of each leg has a pair of small, slightly curved claws and a multibranched empodium, the shaft of which projects beyond tips of claws before subdividing to produce 3 pairs of capitate raylets.

Type Species: *Apostigmaeus navicella* Grandjean, 1944; monotypic.

Apostigmaeus pacificus, n. sp.

(Figs. 1-2)

Female. Basal pieces of chelicerae slender, fusiform; fixed digits membranous, clearly discernible, coextensive with shafts of movable digits (stylets). Basis capituli and upper maxillicoxal areas covered by somewhat thickened, minutely punctate integument or skeleton; this pattern may also appear on coxae I-IV. Posterior setae on basis capituli very slender, finely pointed, ultralong, at least 59 microns, or long enough to reach bases of adoral setae at apex of rostrum. Idiosoma covered mostly with striated integeument; an unpaired propodosomal plate traverses length of propodosoma, from vertical setae to field of cross-striae between dorsocentral setae



Apostigmaeus pacificus, n. sp. (figs. 1–2). Fig. 1, ventral aspect of female; fig. 2, dorsum. Structural detail of dorsal setae *li* (left) and *ce* (right) between the two upper figures. *Eryngiopus gracilis*, n. sp. (figs. 3, 5). Fig. 3., dorsal view of female; fig. 5, its ventral side. *Eryngiopus microsetus*, n. sp. Fig. 4, ventral view of female. Millimeter scale adjacent to figure 4 also applicable to figures 3 and 5.

c; this plate nearly rectangular, long sides parallel, its width slightly greater than distance separating setae of pair *be*; phase microscopy reveals a delicate reticulum thereon; a pair of dot-like apodemal marks or pits occur on its anterior third, one mark close behind each seta of pair *be*. Seta *ae* and *be* arise on front margin of propodosomal plate; all other dorsal body setae except suranals set on very small individual platelets. Suranal region bears a pair of small suranal plates, two seta on each plate, one of pair *e* and one of pair *le*. Dorsal setae plumose, each with numerous fine barbs appressed closely to shaft; 13 pairs, none conspicuously longer than others; external suranals *le* longest; preoculars *be* barely longer than those nearby; verticals *ae* and dorsocentrals *a*, *b*, *c* subequal. Lateral opisthosomal setae *lr* of *A. navicella* absent in this species. Eyes apparently absent. Intercoxal setae smooth, with very finely pointed tips; first pair between coxae II approximately equal to length of third pair between coxae IV; seta of second pair between coxae III very long (70), widely spaced; one or both setae on coxae I-IV also long, longest ones on coxae I, II. Paragenital setae (or aggenital setae) finely plumose, 4 pairs, subequal; setae of anterior two pairs originate on small individual platelets; seta of two posterior pairs planted close together, those of each side share a platelet which surmounts a faintly elevated area. Five pairs anogenital setae, 2 pairs on genital covers, 3 pairs on anal covers; middle pair slightly longer than first and third. Numbers of setae and special sensilla on legs I-IV: femora 4–4–3–3, genua 6–5–3–3, tibia 7–6–6–6, tarsi 14–9–7–7. Average measurements in microns (n = 5): length idiosoma, vertical setae to anus, 475; seta *be* 82, *a* 64, *le* 106. Males not represented in collections.

Types. Holotype: female, Indonesia (intercepted at Hawaii), Sept. 12, 1961, H. A. Woolford and B. F. Wetzel, on *Oryza sativa*; female, Philippine Islands (intercepted at Hawaii), March 24, 1961, H. A. Woolford, *on Manihot esculenta*; female, Philippine Islands (intercepted at Hawaii), April 17, 1959, H. Woolford, on *Oryza sativa*. All in collection of U. S. National Museum.

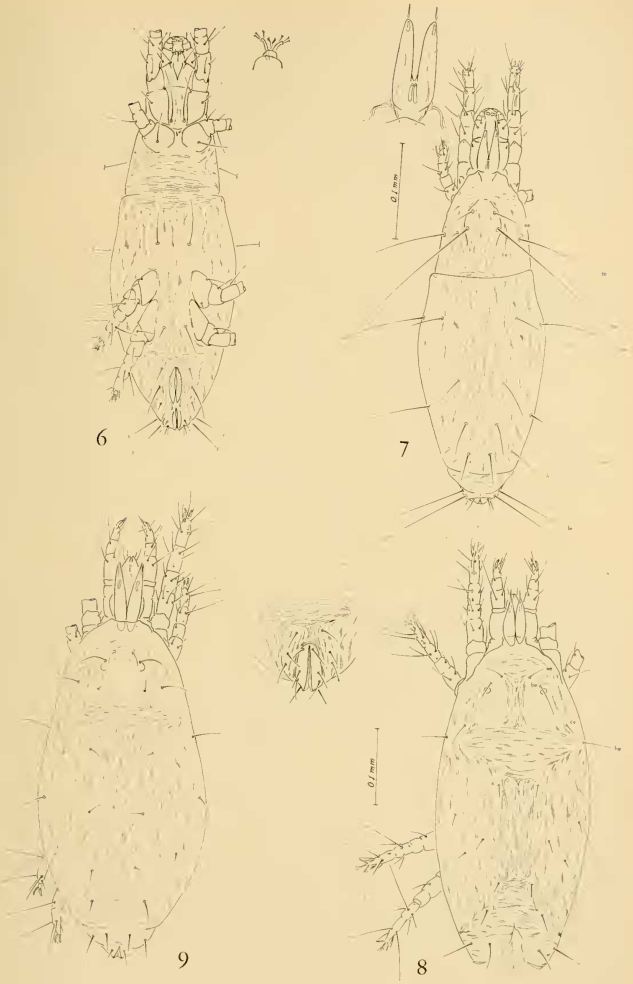
Additional Material. France (Hawaii), March 6, 1961, H. A. Woolford, on *Avena sativa*; Tahiti (Hawaii), March 19, 1961, H. A. Woodford, on *Polianthus tuberosa*; Curundu, Canal Zone, March 10, 1961, C. E. Yunker, on porcupine *Coendu rothschildi*.

A. pacificus is distinguishable from *A. navicella* in many respects. The new species has 13 instead of 14 pairs of dorsal setae and all are plumose. The dorsal propodosomal plate is an elongate rectangle. *A. pacificus* possesses but 2 pairs of setae on the genital covers. The third pair of paragenitals is not longer than the other 3 pairs of paragenitals whereas, in *navicella*, the length of the third paragenitals much exceeds others of the group. Femur IV of *pacificus* has 3 setae instead of 2.

The occurrence of this mite on an animal, a porcupine, is probably fortuitous. This single specimen, probably brushed from low-growing vegetation, is not distinguishable from the other examples studied.

Eryngiopus, n. gen.
(Gr. eryngion, thistle; pous, foot)

Slender bodied stigmaeids with independent chelicerae. Body plating feebly developed and restricted to small raised areas on dorsum of propodosoma and to



Barbutia anguineus (figs. 6–7). Fig. 6 venter of female. Detail of pretarsus I at upper right; fig. 7, dorsum of female, with sketch of chelicerae at upper left. *Eryngiopus longurius* n. sp. Fig. 8, dorsal view of female. Detail of female genital area illustrated in insert between figures 8 and 9. *Eryngiopus vagantis*, n. sp. Fig. 9, dorsum of female.

suranal portion of opisthosoma. Idiosoma extensively covered with very finely striated integument, striae predominantly longitudinal, with few whorls or transverse bands. Terminal sensillum on palptarsus a single spikelet, not a trident or cluster of eupathids. One pair of eyes. Dorsal setae: 12–13 pairs, smooth, short, with small range of variation in lengths between different pairs. Ventral setae smooth, flagelliform, one or more pairs ultralong, especially posterior pair on maxillicoxae. Genital plate or plates absent or feebly developed around bases of posteriormost paragenital setae. Pretarsal claws plain, without accessory rays or tenent hairs. Empodium a slender shaft bearing 3 pairs capitate raylets.

Type species: *Eryngiopus gracilis* n. sp.

Key to Females of **Eryngiopus**

1. Genu II without setae; coxae 2–1–2–1 2
   Genu II with one seta; coxae with a different formula 3
2. Tibia IV with 4 setae; trochanter IV with one seta; 3 pairs of paragenital setae ..... **gracilis** n. sp.
   Tibia IV with 6 setae; trochanter IV without seta; 2 pairs of paragenital setae ..... **microsetus** n. sp.
3. Coxae 1–1–2–1; femora 5–4–3–2; propodosoma with 4 pairs of dorsal setae ..... **vagantis** n. sp.
   Coxae 2–1–2–2; femora 4–4–2–2; propodosoma with 3 pairs of dorsal setae ..... **longurius** n. sp.

Eryngiopus gracilis, n. sp.

(Figs. 3, 5)

Female. Propodosomal plating represented by 2 narrow strips of nude integument between protruding eyes, strips joined together in front, divergent behind, separated medially by wedge-shaped field of longitudinal striae; posterior arms of sclerotized strips attenuated, extend almost to humeral sulcus. Dorsal striae uniformly longitudinal on metapodosoma, transverse only on hinder portion of opisthosoma. Suranal section of opisthosoma delimited by an incomplete transverse fissure; suranal seta *e*, *le* share a denuded area or plate on each side of midline. Dorsal setae simple, comparatively short; humeral setae *he* 27 (all measurements in microns, holotype only), longest of dorsals; dorsolaterals *lm* 13, shortest; all others within this length range. Ventral setae equal to or longer than dorsals; posterior pair on maxillicoxae at least 70, reaches palptarsus when positioned as illustrated; first intercoxal pair 20, second pair 34, third (posterior) pair 27. Three pairs paragenital setae: first 2 pairs equal, not on plates; third pair 50% longer, each seta on an incipient genital platelet. Anogenital covers with 4 pairs setae: 1 pair on genital section, flagelliform, long enough to reach posteriormost extent of anogenital covers; anal section with 3 pairs shorter, more robust setae, subequal, each one less than half as long as setae on genital section. Setae and special sensilla on legs I-IV: coxae 2–1–2–1, femora 4–4–2–2, genua 4–0–0–0, tibiae 6–6–6–4, tarsi 14–9–7–7. Overall length of mite, palpclaw to anus, 495.

Types: Holotype ♀, 5 paratype ♀♀, American Canyon, Solano County, California, February 15, 1951, from willow bark. Holotype

retained in collection at Davis, paratypes deposited in United States National Museum and British Museum (Natural History). No other specimens taken.

The possession of only four setae on tibia IV separates *E. gracilis* from its present congeners. Although none of the intercoxal setae on the podosoma is conspicuously long, their relative lengths provide an additional basis for recognizing this species, i.e., second pair > third pair > first pair.

Eryngiopus vagantis, n. sp.
(Fig. 9)

Female. Dorsal plate of propodosoma integral, not invaded by longitudinal striae, covers entire elevated area bounded by eyes and setae *ae, be, ce*, its posterior margin adjoins belt of transverse striae between propodosoma and metapodosoma. A pair of small, circular apodemal marks anteriorly on propodosomal plate, one mark behind each vertical seta, both marks aligned with preocular setae. Dorsal setae fine, smooth, with several size ranges: *be* longest 41; *ae, ce, a, b, c, lm* subequal, 17–20; others of intermediate lengths. Ventral setae ultralong, flagelliform: posterior pair on maxillicoxae 75; first pair intercoxals 30, shortest of its series; second pair at least 80; third pair at least 64. Paragenital setae: 3 pairs, not on plates; first pair 24, second pair 30, third pair 40. Anogenital covers with 4 pairs setae; anteriormost pair flagelliform, approx. 1.5 times longer than each of 3 pairs which follow in succession. Coxae 1–1–2–1, femora 5–4–3–2, genua 4–1–0–0, tibiae 6–6–6–6, tarsi 14–9–8–8. Overall length, palpclaw to anus, 560.

Types: Two co-type ♀♀, 2 paratype ♀♀, 2 nymphs, Napa, Napa County, California, December 22, 1959 (S. F. Bailey and R. O. Schuster), from prune orchard. One co-type deposited in United States National Museum; one paratype in British Museum (Natural History); others filed in mite collection, University of California, Davis.

E. vagantis has several unique features: coxa I has only 1 seta; femur I has 5 and femur III has 3 setae; the dorsal propodosomal plate is not partitioned by median longitudinal striae. The middle (second) intercoxal seta is ultralong; second pair > third pair > first pair.

Eryngiopus microsetus, n. sp.
(Fig. 4)

Female: Body dimensions noticeably smaller but otherwise much like *gracilis* in respect to patterns of striae and relative lengths of dorsal setae. Propodosomal plating feebly developed, represented by a pair of nude areas confined to region of eyes and first 2 pairs of setae, possibly not joined together between bases of vertical setae. Ventral setae all longer than dorsals; posterior pair on maxillicoxae 54 (microns), extends forward to distal ends of palpgenua; first intercoxals ultralong, 72; second intercoxals at least 40; third intercoxals about 45. Only 2 pairs of paragenital setae, none originate on plates. Trochanter IV with seta absent. Coxae 2–1–2–1, femora 4–4–2–2, genua 4–0–0–0, tibiae 6–6–6–6; tarsi 14–10–8–8. Overall length, palpclaw to anus, 410.

Holotype: Female, Moss Beach, San Mateo County, California, no date recorded (W. H. Lange and E. I. Schlinger), from leaf mold under Monterey Cypress. Only example, filed in mite collection, University of California, Davis.

E. microsetus has at least two characters not shared by the other known species: There are only 2 pairs of paragenital setae and trochanter IV bears no seta. First intercoxal seta is ultralong; first > third > second.

Eryngiopus longurius, n. sp.
(Fig. 8)

Female. Plated area of propodosoma completely bisected in midline by a wide band of longitudinal striae; each half of plate triangular in outline, with setae *ae* on or adjacent to its vertex, its base adjoins broad belt of transverse striae on front of metapodosoma; areas referred to as plates also bear extremely faint longitudinal striae. A thinly sclerotized suranal plate arches over hinderpart of opisthosoma. Integumental striae with microtubercles or lobules at widely spaced intervals. Patterns of dorsal striae peculiar to species: extensive bands of striae cross front and rear ends of hysterosoma; longitudinal rows whorl between dorsocentral setae *a* and *b* to create an elongate rectangular figure on middorsum of metapodosoma. Dorsal setae smooth, 12 pairs only—presumably postoculars *ce* absent on propodosoma; *be* = *le*, longest of dorsal setae, 40; *la* 15, *lm* 12, shortest in the dorsal group. Only one pair of ventral setae ultralong: posterior setae on maxillicoxae at least 68; all coxals and intercoxals relatively short, subequal: first intercoxals 24, second 24, third 20. Chaetotaxy of ventral opisthosoma not distinguishable from *vagantis*. Coxae 2–1–2–2, femora 4–4–2–2, genua 4–1–0–0, tibiae 6–6–6–6, tarsi 14–10–8–7. Numerous setae uppermost on appendages unusually long, flagelliform, e.g.: dorsal seta on tibia III 50, on tibia IV 68; dorsal setae on tarsus IV at least 64. Overall length, palpclaw to anus, 550.

Male. Somewhat smaller than female, 480 overall, but recognizable according to qualitative characters ascribed to podosoma of opposite sex. Opisthosoma with most structural features common to other stigmaeid males. Dorsal striae whorl between setae *a* and *c* to form rectangular figure.

Types. Holotype ♀, allotype ♂, Nortonville, Contra Costa County, California, Oct. 15, 1952 (W. C. Bentinck), from saltgrass (*Distichlis* sp); Paratype ♀, 7 mi. west of Parker Dam, San Bernardino County, California, Feb. 24, 1951 (C. D. McNeill) from soil in shrub thicket. Holotype in U. S. National Museum, others retained in collection at Davis.

Microtuberculate striae and the whorling of striae middorsally between setae of pairs *a* and *c* are useful spot characters for *E. longurius*. There are only 12 pairs of dorsal setae whereas 13 pairs is the common number. Also unique is the presence of 2 setae on coxae IV. The intercoxal setae on the podosoma are comparatively short and subequal.

Barbutia Oudemans 1927

Small, emphatically fusiform species, with humeral sulcus clearly a line of body flexion. Chelicerae fused together along basal halves to form a U-shaped stylophore. Short peritremata on dorsomedian surface of stylophore. Idiosoma without obvious plates; a broad, ovoid elevation with 2 pairs setae occurs on propodosoma, between eyes; integument covering elevation striated and possibly more rigid than integument elsewhere. Thirteen pairs dorsal setae, some ultralong. One pair of eyes. Genital and anal apertures of female proximate but not sharing common covers; genital covers without setae; 3 pairs paragenital setae. Pretarsi sessile; claws diminutive, each claw with 2 pairs tenent hairs; these very short, capitate. Minute empodium with possibly 2 pairs capitate raylets.

Type Species: *Stigmaeus anguineus* Berlese, 1910. Monotypic.

Barbutia anguineus (Berlese)
(Figs. 6–7)

Stigmaeus anguineus Berlese, 1910, Redia 6:204.
Stigmaeus (*Macrostigmaeus*) *anguineus*, Berlese, 1910, Redia 6:208.
Macrostigmaeus anguineus, Oudemans, 1923, Ent. Ber. Nederland. Ent. Ver. 6:146.
Barbutia anguineus, Oudemans, 1927, Ent. Ber. Nederland, Ent. Ver. 7:260.

Female. Chelicerae with short, anteriorly directed stylets; proximal segments fused together near basal ends to form a deeply cleft, U-shaped stylophore. Peritremata located on dorsomedian surface of stylophore; these comprise a pair of juxtaposed tubes, or grooves, which extend straight backwards a short distance from points of origin in apex of cheliceral notch. Palpi with tibial claws opposable, tending to meet slightly in front of cheliceral stylets; each claw large in relation to segment which bears it, and equipped with a sharp spine, or tooth, on its concave edge. Palptarsi noticeably club-like, swollen at distal ends. Rostrum truncate anteriorly, lateral lips flared, with 2 pairs inconspicuous adoral setae. Propodosoma with smaller girth than hysterosoma, humeral sulcus appears to allow telescoping of those body sections; dorsomedian surface of propodosoma surmounted by a broad, oval elevation. One pair of eyes. Integument of dorsum entirely striated, striae faint, predominantly longitudinal and with small granules disposed at widely spaced intervals along or between them. Striae of venter without granular ornamentation; a wide belt of transverse striae occupies sternal area behind coxae II; those in vicinity of propodosomal-hysterosomal junction assume form of broader, interdigitating rugae. Sclerotized plates not evident. Thirteen pairs completely smooth dorsal setae, all flagelliform, most so finely pointed that total lengths cannot be precisely determined; setae classed in 4 size ranges with approximate lengths and presumed homologies with corresponding setae of other stigmaeids as follows: ultralong—*be* 156, *e* 144; long—*de* 82, *he* 86, *lm* 86, *le* 94; intermediate—*a* 51, *b* 39, *c* 31, *li* 39; ultrashort—*ce* 12. Ventral setae of intercoxal areas: first pair 55, reaching from base of coxa I to palptrochanter; second pair 39; third pair 27. Three pairs paragenital setae, middle pair longest: first 12, second 31, third 8. No setae on genital covers; 3 pairs on anal covers, short, subequal. Inclusive counts of setae on leg segments: coxae 2–1–2–0, femora 4–3–2–2, genua 6–0–0–0, tibiae 6–5–3–3, tarsi 12–8–8–8. Sensillum *k* on genu I solenidiform, not spine-like. Tarsi abruptly rounded distally,

without tapered peduncles; claws very small, each with 2 pairs capitate raylets arising near its distal end. Empodium with one pair, or possibly 2 pairs, capitate raylets. Length of mite when positioned as illustrated, palpclaw to anus, 418.

Male. Closely resembles female in respect to prosoma and legs I-II; extra (male) solenidion does not appear on tarsi I-II; solenidion on tarsi III-IV noticeably larger and dorsal setae on hysterosoma much shorter than described for female. Opisthosoma conical, with 1 pair paragenital setae below. Aedeagus a slender, straight shaft, upcurved near tip.

Distribution. One collection, 5 specimens, Pigeon Point, San Mateo County, California, July 12, 1958, D. W. Price, from mulch in shrub thicket.

Berlese's original illustration of *B. anguineus* is complete enough to allow probable identification of the species without reference to type specimens. He did not, however, give sufficient information about peritremes, claws and general chaetotoxy to reveal its distant affinities with species in other stigmaeid genera. Oudemans (1927) separated *Macrostigmaeus serpentinus* Berl. and M. *anguineus* Berl. by creating a new genus, *Barbutia*, for the latter. In 1931, he assigned both genera to his new family, the Stigmaeidae.

Although other genera of this family contain small fusiform species having almost no plate-like armature, *Barbutia* is unique in several respects: the palpi appear to function as opposable, pincer-like appendages; the stylophore bears dorsal peritremes, as in caligonellids; and the claws have raylets or tenent hairs, as in tetranychoids. Also the genital and anal pores are independently covered and the chaetotaxy of the legs deviates considerably from stigmaeid patterns. Since *Barbutia* cannot be properly referred to any other family in the presently constituted superfamily Raphignathoidea, it is expedient to maintain the *status quo* until the systematics of this group of families is better understood.

Grandjean's nomenclature of dorsal setae is applied to *B. anguineus* without certainty of the true homologies. The humeral setae *he* and the first lateral hysterosomals *la* are the key setae in question. If the writer's assumption happens not to be the correct one of several possibilities, then the labels applied to at least seven of the hysterosomal setae (fig. 7) would be improper.

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THE ALTERNATE GENERATION OF CALLIRHYTIS AGRIFOLIAE (ASHMEAD)

(HYMENOPTERA: CYNIPOIDEA)

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The gall produced by the cynipid wasp *Callirhytis agrifoliae* (Ashm.) on the oaks *Quercus agrifolia* Nee and *Quercus Wislizenii* A. DC. in California is one of the most abundant galls in this area. The gall is a beautifully mottled, spherical, monothalamous (one-chambered) growth that develops in the axils of the leaves during the summer and early fall, grows rapidly for several months and then drops to the ground where it remains until the adult insects emerge during the early months of the following year. (Figure 1 A, B). Mature galls are 4.8-5.4 mm. in diameter and contain a thick layer of nutritive tissue around the central larval cell. It is upon this material that the tiny larva feeds and grows until it pupates in the late months of the year. Mature agamic or unisexual females emerge from the galls in late January and in February; earlier in some areas.

The species was originally described by H. F. Bassett (1881:53) however the first valid name was used by William Ashmead (1885:294). *Andricus wisliceni* (Ashmead) and *Callirhytis clarimontis* Kieffer are considered to be synonyms (Weld, 1951:647). Until the present time the species has been known only from descriptions of the agamic females which have been reared in large numbers. Specimens are exceedingly easy to obtain and to rear for the galls are often so numerous that they literally cover the ground and when gathered in December or January will nearly always yield adults. No males have been described.

Recent investigations in California have shown heterogony or alternating unisexual and bisexual generations occur as a regular part of the life cycle in several genera of the phytophagous Cynipidae on the Pacific Slope. Such alternate generations have been demonstrated in the genera *Andricus* (Doutt, 1960) *Callirhytis* (Lyon, 1959) *Dryocosmus* (Doutt, 1959) and *Heteroecus* (Lyon, MS in press). Circumstantial evidence indicates the existence of heterogony in the genera *Antron* and *Loxaulus*. With these facts in mind, it is surprising that the alternate generation has not been worked out for a species as abundant and as easy to rear as *C. agrifoliae* (Ashm.).

During the second week of February 1963 a number of agamic females emerged from galls in rearing cages and were placed on young oaks growing in five-gallon containers. The insects were at first allowed to move freely on the young trees in order to ascertain that portion of the plant in which they would oviposit. The females immediately began to oviposit in the tightly packed leaf buds and spent 20 to 30 minutes on the first leaf buds that they encountered. As they moved from bud to bud, oviposition time decreased until only 5 to 10 minutes were spent on each bud. The temperature was 60 to 64° F., but as it gradually became warmer the insects began to fly off the plants. Later in the day the females were confined to individual cloth bags placed over the twigs. The insects did not appear to be highly selective in their choice of buds

and readily accepted buds that had already been visited by other females. All sites of oviposition were carefully marked.

The new leaves began to unfold on March 1st and by the time the leaves were fully expanded, tiny red blister galls were visible on the leaf veins. Agamic females continued to emerge throughout March and early April and were placed on the plants shortly after emergence. Oviposition again took place but fewer galls developed from these late females and many that did develop, failed to mature properly. The percentage of gall failure was quite high even when oviposition took place earlier in the year. Oviposition in the leaf causes it to buckle at the point where the egg is placed whether or not a gall develops. When the gall fails to develop, the spot where the egg was laid turns brown and later a tiny hole develops. Gall development was very rapid with the galls attaining full size by the time the leaves were fully developed. The insects were in the pupal stage by late March and adults of both sexes began to emerge on April 5th. Emergence continued until April 15. On experimental trees, 48 days elapsed between the time of oviposition and the emergence of the bisexual generation from the mature galls. The males were very active and immediately began to fly about in search of females. The latter move rather slowly and when disturbed will drop from the leaf rather than fly. It is interesting to note that agamic females were still emerging in the rearing cages when specimens of the bisexual generation had matured and were emerging from their galls.

Description of the Gall (Figure 1C, D, E, F). The adults of the bisexual generation produce galls of several different types. The most common type is a small, one-celled blister, 2 mm. long, that develops in the central or lateral veins of the new leaves. New galls are green, tinged with red and as they develop, the color deepens. At maturity they are tan, microscopically pubescent and very thin-walled. The exit hole made by the adult gall wasp may be on either the upper or lower surface of the leaf. Another type of gall develops as an almost imeprceptible swelling in the petiole of an apparently normal leaf. Sometimes the leaf aborts, but the petiole remains in the form of a tiny gall. Still another type develops at the terminal end of the shoot or in the axils of the leaves at the base of a tiny aborted bud. Galls are surprisingly difficult to locate on the native trees in spite of the fact that the agamic females are numerous. One can only speculate as to the reasons for this and in all probability their scarcity is the result of a combination of factors. In the first place they are exceedingly small, inconspicuous and are easily overlooked. Secondly, on experimental trees many failed to develop into mature galls. Finally, as is usually the case with leaf galls, a high percentage was parasitized by chalcids.

BISEXUAL GENERATION

Female: Rather strikingly different from the agamic females primarily because of size and color. The head and body are black, legs amber, yellow in some specimens, except the base of the front and middle coxae

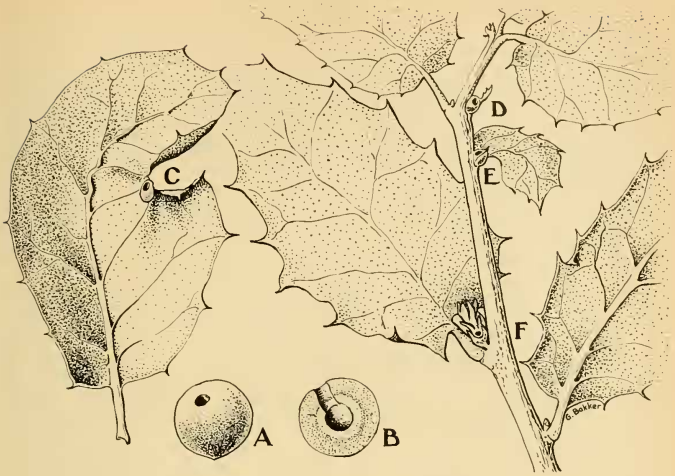

Figure 1. A, Spherical, monothalamous gall produced by the agamic generation of *Callirhytis agrifoliae* (Ashm.); B, A single gall of the same showing position of the larval cell; C, Leaf gall of the bisexual generation showing the typical bent appearance of the leaf; D, Petiole gall of the same showing aborted leaf; E, Petiole gall in normal, small leaf; F, Gall of bisexual generation developed in an aborted bud.

which are smoky; hind coxae entirely dark; distal tarsal segments as well as the terminal antennal segments also darkened; eyes black, ocelli amber. Head: granular in texture similar to the agamic females, however there are prominent fan-striae on the face and in the malar space. These are inconspicuous in the agamic females. Malar space nearly one-half the length of the eye. The interocular area is two and one-half times as wide as high. In the agamic females this area is three and one-half times as wide as high. The head is scarcely broadened behind the eyes whereas the head bulges conspicuously behind the eyes in the agamic females. The antennae are 14-segmented with the terminal segments distinctly fluted. Mesoscutum: anterior parallel lines not readily visible; lateral lines not impressed and represented by smooth bands. These lines are conspicuous in agamic females. Scutellum: disk entirely rugose; agamic females rugose except center which is pebbled. Ventral spine very short, twice as long as broad. Agamic females with longer ventral spine, 7X as long as broad. Wings in the bisexual generation are pubescent and ciliate with very dark veins. Agamic females also have pubescent and ciliate wings but the amber veins and cilia give them a much lighter appearance. Range in length of 25 specimens

1.3—1.8 mm. Average length 1.7 mm. Agamic females range from 3.1—3.8 mm. in length.

Male: Average size slightly smaller than female. Antennae with 15 segments; eyes very large with interocular space only twice as wide as high; malar space very narrow and only one-sixth the length of the eye; abdomen very thin-walled often collapsed in pinned specimens. Tergites II and III are usually the only tergites visible along the dorsal curvature of the abdomen. Range in length of 24 specimens 1.3—1.7 mm. Average length 1.6 mm.

Types: The types and ten paratypes are in the collection of the U. S. National Museum. Other paratypes are in the collections of the California Academy of Sciences, University of California at Los Angeles and the Los Angeles County Museum.

Host: *Quercus agrifolia* Nee.

Habitat: The types were reared from galls produced on potted oaks in La Crescenta, California. Additional specimens were reared from galls collected on the native oaks in the Los Angeles area.

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Summary: An alternate, bisexual generation occurs in the gall wasp *Callirhytis agrifoliae* (Ashm.) previously known from agamic emales only. Heterogony has not been previously demonstrated in this species. The gall, produced by the alternate generation is a tiny, single-celled gall that develops in the veins of the leaves, in the petiole, or in the base of auxillary buds on *Quercus agrifolia* Nee and *Quercus Wislizenii* A. DC. during the months of March and April.

[1] Now deceased.

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HENRY SHEPARD FULLER
1917-1964

Henry S. Fuller, M.D., internationally known medical entomologist and microbiologist, died of a sudden heart attack at Camp Zama, Japan, on February 3, 1964.

Shep, as he was called by his family and associates at Plummers Island to distinguish him from his father, Henry C., or Hank, as he was called by friends in other circles, was born June 17, 1917 in Washington, D. C. There he received his early education in the public schools. In 1937, he was awarded a B.S. degree in chemistry from Worcester Polytechnic Institute in Massachusetts. The following academic year he enrolled in Harvard Medical School, from which he received the degree M.D. *cum laude studiorum peculiarium causa* in 1941.

Following a year of internship at the Massachusetts General Hospital in Boston he was commissioned a first lieutenant in the Medical Corps of the U. S. Army. He was promoted to captain during the war and received a terminal leave promotion to major.

After his military service Harvard awarded him a Moseley traveling fellowship which enabled him to continue postgraduate studies at the London School of Hygiene and Tropical Medicine during the academic year 1946-47. There he was awarded the William Simpson prize and the Lalcaca medal for the high quality of his academic work. During the following year he was appointed assistant professor of preventive medicine at the Bowman Gray School of Medicine at Wake Forest College in North Carolina, and served concurrently as a medical officer in the Tropical Disease Clinic of the Veterans Administration Regional Office in Winston Salem. Thereafter, he returned to the Harvard School of Public Health for the period 1949-53 where he was first a research associate in medical entomology and then an assistant professor of microbiology. He received the degree of Master of Public Health *magna cum laude* from Harvard in 1951.

In 1953, he returned to government service, this time as a civilian scientist with the Department of the Army, an association which lasted until his untimely death this year. Working at the Walter Reed Army Institute of Research, he was assistant chief and later chief of the Department of Entomology. In 1956, he became chief of the Department of Rickettsial Diseases. He held this position until the summer of 1963 when he accepted an assignment for what was to have been a 2-year tour of duty as chief of the Department of Virus and Rickettsial Diseases at the 406th Army Medical General Laboratory at Camp Zama, Japan.

Shep was a brilliant scholar with a wide range of interests. His father, although a chemist, had a deep interest in natural history and was a long-term member (1910-42) and former president of the Washington Biologists' Field Club. Some of Shep's earliest recollections were of many trips he made with his parents and sisters up the Potomac River to Plummers Island, the home of that Club. Many distinguished naturalists—H. S. Barber, E. A. Schwarz, A. K. Fisher, A. Wetmore, W. L.

McAtee, S. F. Blake, H. H. T. Jackson and F. C. Lincoln—were fellow members with the elder Fuller during those years. Their specialized interests included entomology, ornithology, mammalogy and botany. From them young Fuller got a broad acquaintance with the diverse forms of life and developed a love of nature which remained at the very core of his being for the rest of his life. Plummers Island and its associations were an intimate part of his life during his boyhood years, and again during his last 15 years after he himself was elected to membership in 1949.

Because of his deep love of nature, Shep was very fond of Thoreau and was inspired by his writings. At Plummers Island he experienced the tranquil solitude of one of earth's lovely spots. It was to this retreat that he went with increasing frequency during the unhappy later years of his second marriage. For him Plummers Island was an earthly "green pasture" in the true sense of the psalmist.

He was a very witty person with an irrepressible tendency to pun and a love for playing with words. For example, he would take a word like somersault, scramble the letters, and come up with a number of plausible-sounding nouns for which he would formulate appropriate definitions. I now recall only two—"molestraus" and "moustrels;" he defined the latter as "wee, furry minstrels." For years our (HSF and KVK) standard greeting was the silly phrase, "Dr. Stomcock, I presume," a play on the name of the eminent pioneer entomologist, J. H. Comstock.

He was impatient with pompous, long-winded people who suffered from "diarrhoea of the vocal cords." When the occasion warranted, he had a sharp tongue; his inelegant, though highly appropriate term for these individuals was "foldy old marts."

During the period 1958-62, he was the perennial chairman of the House and Grounds Committee at Plummers Island, a group which he fondly and facetiously called the "Grouse and Hounds" Committee. He performed this assignment with great devotion, and at times with a degree of personal inconvenience. On one lovely spring day Fuller, armed with elbow length, heavy rubber veterinarian gloves, assumed the uninviting task of emptying the well-rotted contents of the box latrine into heavy grocery sacks, which were then carted downhill by Krombein. This exploit prompted a cryptic notation by Fuller in the Club register to the effect that we "removed certain formed objects as well as grossly amorphous material from the smaller of the two buildings on the property."

Shep was a firm believer in the purity and potability of the water accumulated in a rain barrel from the cabin roof at the Island. Each spring this water went through a fermentation cycle caused by percolation through the oak catkins in the gutters. The end product had a foul taste, but, confident that the periodic checks at Walter Reed showed the water to be at least bacteriologically safe, he drank it in preference to the "citified," chlorinated product that others of us lugged up to the Island. I can recall my consternation at one of our spring shad bakes when this water, used as a mixer, turned whiskey

Henry S. Fuller, Plummers Island, May 1961

green. Shep looked upon this as evidence that the whiskey could not have been very good.

As a result of boyhood contacts with his father's colleagues in the Washington Biologists' Field Club at Plummers Island, principally H. S. Barber the noted coleopterist, he developed an interest in Coleoptera. But even during these early years he was attracted to medical entomology, and at the age of 12 he received an award from the Gorgas Memorial Institute for an essay on malaria. The prize was presented to him by President Hoover. Perhaps this early interest in medical entomology was stimulated by another of his father's colleagues at Plummers Island, A. K. Fisher, a medically trained naturalist. Some years later Fisher, in co-sponsoring Shep for membership in the Cosmos Club, wrote: "Maybe I had some little influence in developing his interest in medical-biological research, as among other things the subject of insects as disease carriers often entered our conversation, and I led him to have deeper interest in the study of mosquitoes and fleas." During his years in the Harvard Medical School, and under the guidance of J. C. Bequaert, Fuller extended his knowledge of arthropods of medical importance. His first scientific papers, written during this period, were principally on fleas and their taxonomy.

Shep was one of the rare medical officers to be commissioned in World War II with a background of medical entomology. In spite of his

unique background, the vagaries of the Army classification system led to a routine assignment as a laboratory officer in a field hospital. He could have stagnated in an area of relative entomological sterility like England or France. Fortunately for him (and more so for the Army), this hospital was sent to the China-Burma-India theater where arthropod-borne diseases were a tremendous problem. On his own initiative, and during time off from laboratory duties, Fuller soon undertook field studies in Burma and Assam on the ecology of scrub typhus and the bionomics and taxonomy of the vector chigger *Leptotrombidium deliensis*. The quality and importance of these investigations led to his subsequent assignment in October 1944 to the U. S. Typhus Commission in the CBI theater for the duration of the war. He was awarded a Bronze Star Medal by the Army for his meritorious achievements over and above the call of duty in the ecological study of scrub typhus. He was also awarded the medal of the U. S. Typhus Commission.

His interest in rickettsial diseases and their arthropod vectors continued after the completion of his military service during World War II. Important contributions to an understanding of the ecology of rickettsialpox and of the life cycle of the mite vector, *Allodermanyssus sanguineus*, were made during his tenure at the Harvard School of Public Health. While at Walter Reed Army Institute of Research, he was sent overseas once again as a member of a team to study Far Eastern Hemorrhagic Fever. In Korea, he undertook entomological investigations of the mites thought to be associated with the transmission of the disease. After his return to Washington he carried out extensive studies of the human body louse and its infection with agents of epidemic typhus and trench fever. In collaboration with an investigator at the Harvard School of Public Health, studies on trench fever led to the successful cultivation of the etiologic agent on artificial media. Shep experimentally inoculated himself with material from infected lice, contracted a clinical case of trench fever, and provided the blood from which the microorganism was first grown. More recently he directed a coordinated field and laboratory investigation into the ecology of Rocky Mountain spotted fever, in collaboration with the Virginia State Department of Health. For the first time in North America it was demonstrated that several species of native wild mammals harbor *Rickettsia rickettsii* incriminating them as possible vertebrate reservoirs. In recognition for his outstanding and distinguished performance of duty at Walter Reed Army Institute of Research he was awarded a Certificate of Achievement in July 1963.

During the few remaining months of his life in Japan he returned to a subject of earlier interest, the ecology of tsutsugamushi disease. In my (KVK) last letter from him (mid-November, 1963) he mentioned that he had just been on field maneuvers for 8 days with the U. S. Marines on the slopes of Mt. Fuji. There he collected "wee furry beasts with chiggers" and took blood samples from 575 Marines. During the week prior to his death he was again in the field with the Marines. Upon his return he was greeted by a large sign in the Marine Officers' Mess, "Welcome home, Hank," and with the announcement that they

had ordered a uniform for him and were going to make him an honorary Marine. Just 2 days later he suffered a fatal heart attack.

Fuller was fully aware of the importance of systematics in relation to his investigations on arthropod-borne diseases of man. While in Europe he had the opportunity to study the chiggers in the Oudemans' collection in Leiden; this resulted in the publication of a fundamental study on the taxonomy of these species in 1952. The same year, in collaboration with G. W. Wharton, he published a manual of chiggers. The latter work, especially, provided the necessary foundation for the systematic study of the chiggers of the world. He was a valued invitational lecturer on the relations of Acarina to rickettsial diseases at the Institute of Acarology during the summers it was held at the University of Maryland. He was an invitational lecturer on this subject at the Johns Hopkins School of Hygiene and Public Health also. In 1961 he was tendered, but declined, a professorship at Johns Hopkins.

The historical development of medical entomology was a collateral interest to which Fuller devoted much of his limited leisure time. In 1959 he received a grant from the American Philosophical Society to aid in the preparation of a critical history of medical entomology. Considerable progress was made on this project during 1960. He reported in the 1961 yearbook of that Society that he had completed: "A critical, annotated translation of correspondence during 1724 between Vallisnieri and Gherli concerning lice and the so-called *morbus pedicularis*; a bibliography of the lice of man (approximately 3,600 titles); and medical entomology in the eighteenth century." It is to be hoped that one or more of these fragments are complete enough to permit publication as separate essays or bibliography. It is a pity that Fuller could not have lived to complete this critical history, for his lucid style of discursive writing would have made it a highly readable one. His broad biological background and highly developed critical sense would have made it an invaluable analysis of the historical development in this important field of entomology.

He was a member of many scientific societies including the Biological Society of Washington, Entomological Society of Washington, Entomological Society of America, Washington Academy of Sciences, American Society of Microbiology, American Academy of Microbiology, American Association of Immunologists, American Society of Parasitologists, American Association for the Advancement of Science, American Society of Tropical Medicine and Hygiene, Royal Society of Tropical Medicine and Hygiene, and Sigma Xi National Honorary Research Fraternity. He was also a member of the Commission on Rickettsial Diseases of the Armed Forces Epidemiology Board.

His social clubs were the Cosmos Club and the Washington Biologists' Field Club. He cherished his memberships in these and made many enduring friends among his fellow members. In his characteristically precocious way he was elected to the Cosmos Club before he was 29, very few men having been admitted so young. However, the Washington Biologists' Field Club and its home at Plummers Island were a vital part of his life from his earliest memories. In discussing our memberships in various societies and clubs we (HSF and KVK) opined that if